

CLAIMS

We claim:

- [c1] 1. A method in a client computing device for enabling authors to work on a hierarchical document, comprising:
- retrieving a local copy of the hierarchical document from a server computing device;
 - receiving an indication of a requested mutation from a user;
 - sending a message to the server computing device containing the requested mutation;
 - when the requested mutation is successfully applied by the server computing device to the hierarchical document, receiving a message from the server computing device acknowledging a successful mutation to the hierarchical document; and
 - when the requested mutation is not successfully applied by the server computing device to the hierarchical document, receiving a message from the server computing device containing an indication to revert the local copy of the hierarchical document to a current form of the hierarchical document on the server computing device.
- [c2] 2. The method of claim 1 wherein an application program is the user.
- [c3] 3. The method of claim 1 wherein an author is using an application program relating to the hierarchical document.
- [c4] 4. The method of claim 3 wherein the author makes a change to the document using the application program and further wherein the indication of a requested mutation relates to the change.
- [c5] 5. The method of claim 1 wherein messages are represented in XML.

- [c6] 6. The method of claim 5 wherein the message is contained in a frame.
- [c7] 7. The method of claim 6 wherein the frame comprises multiple messages.
- [c8] 8. The method of claim 5 wherein when the message from the server computing device is received, the message contains no nodes that the author is not privileged to read.
- [c9] 9. The method of claim 1 wherein the requested mutation is not successfully applied when the user is not privileged to make the requested mutation.
- [c10] 10. The method of claim 1 wherein the requested mutation is not successfully applied when the requested mutation conflicts with a mutation previously made to the hierarchical document on the server computing device.
- [c11] 11. The method of claim 1 wherein the message containing an indication to revert the document comprises sufficient information to determine the current form of the hierarchical document on the server computing device.
- [c12] 12. The method of claim 1 wherein the message acknowledging the mutation includes additional mutations to be applied to the local copy of the hierarchical document.
- [c13] 13. A system in a client computing device for enabling authors to work on a hierarchical document, comprising:
 a component that retrieves from a server computing device the hierarchical document and making a local copy of the retrieved hierarchical document;

a component that receives from a user an indication of a requested mutation to the local copy of the hierarchical document;
a component that sends to the server computing device a message containing the requested mutation; and
a component that receives from the server computing device a message indicating whether the requested mutation was successfully applied to the hierarchical document.

[c14] 14. The system of claim 13 wherein when the requested mutation was not successfully applied, the message received from the server contains information relating to a current form of the hierarchical document sufficient to mutate the local copy to reflect the current form of the hierarchical document on the server computing device.

[c15] 15. The system of claim 13 wherein the message from the server computing device arrives in a frame.

[c16] 16. The system of claim 15 wherein the frame comprises multiple messages.

[c17] 17. The system of claim 15 wherein the frame has an indication of a first message identifier and a last message identifier.

[c18] 18. The system of claim 17 wherein the component that receives the message from the server determines whether a message was missed.

[c19] 19. The system of claim 18 wherein a message is missed when the first message identifier exceeds, by more than a predetermined number, an identifier of a last message previously received from the server computing device.

[c20] 20. The system of claim 19 wherein the predetermined number is one.

[c21] 21. The system of claim 13 including a component for determining whether a DDOM fragment can be used to handle the requested mutation.

[c22] 22. The system of claim 21 wherein the DDOM fragment can be used before a node is added to the hierarchical document.

[c23] 23. The system of claim 21 wherein a node is added to the DDOM fragment before the DDOM fragment is added to the hierarchical document.

[c24] 24. The system of claim 21 wherein a mutation is made in relation to the node.

[c25] 25. The system of claim 21 wherein the message containing the requested mutation is not sent to the server computing device.

[c26] 26. A method in a server computing device for enabling authors to work on a hierarchical document, comprising:

for each author,

providing to a client computing device a copy of the hierarchical document;

receiving from the client computing device an indication of a mutation request;

attempting to apply the received mutation request to the hierarchical document;

when the mutation cannot be applied to the hierarchical document,

sending to the client computing device a message containing an indication to revert the client copy of the hierarchical document to a current form of the hierarchical document; and

when the mutation can be applied to the hierarchical document,

sending to the client computing device a message containing an indication of an applied mutation.

[c27] 27. The method of claim 26 wherein the indication of the applied mutation is sent as an answer to the client computing device.

[c28] 28. The method of claim 26 wherein the indication of the applied mutation is sent as a broadcast message to a second client computing device having a copy of the hierarchical document.

[c29] 29. The method of claim 28 wherein when the broadcast message is received by the second client computing device after the second client computing device has sent a requested mutation message but before the second client computing device receives an answer, the mutation indicated in the broadcast message is applied to the client copy of the hierarchical document.

[c30] 30. A method in a distributed computer system for sharing a hierarchical document, comprising:

receiving at a server computer system a hierarchical document from a document source client computer system;

distributing to a client computer system other than the document source client computer system the hierarchical document;

receiving from a client computer system a mutation request to be applied to the hierarchical document;

sending to the client computer system from which the request was received a response message containing an answer; and

sending to a connected client computer system other than the client computer system from which the mutation request was received a broadcast message.

[c31] 31. The method of claim 30 wherein the distributing occurs when a client computer system other than the document source client computer system requests the hierarchical document.

- [c32] 32. The method of claim 30 wherein the mutation request is received from the document source computer system.
- [c33] 33. The method of claim 30 wherein the mutation request is received from a client computer system other than the document source computer system.
- [c34] 34. The method of claim 30 wherein the mutation request is to delete a node.
- [c35] 35. The method of claim 34 wherein the node is placed into a pool of deleted nodes.
- [c36] 36. The method of claim 30 wherein the pool is periodically cleared.
- [c37] 37. A method performed by a computing device for enabling authors to work on a hierarchical document, comprising:
 retrieving the hierarchical document from another computing device;
 modifying the retrieved hierarchical document;
 sending an indication of the modification to the other computing device; and
 when the sent modification cannot be applied to the hierarchical document on the other computing device, reverting the hierarchical document to a current form of the hierarchical document on the other computing device.
- [c38] 38. The method of claim 37 wherein the modifying includes adding a node.
- [c39] 39. The method of claim 37 wherein the modifying includes removing a node.

- [c40] 40. The method of claim 37 wherein the modifying includes changing values relating to an attribute of a node.
- [c41] 41. The method of claim 37 wherein the indication is a message comprising a mutation request.
- [c42] 42. The method of claim 41 wherein contents of the message are represented in XML.
- [c43] 43. The method of claim 41 including receiving an indication that the modification was successfully applied when the sent modification is applied on the other computing device.
- [c44] 44. The method of claim 43 wherein the indication is a message.
- [c45] 45. The method of claim 44 where contents of the message are represented in XML.
- [c46] 46. The method of claim 37 including receiving an indication of a failure when the sent modification cannot be applied on the other computing device.
- [c47] 47. The method of claim 46 wherein the indication includes information relating to the hierarchical document sufficient to determine the current form of the hierarchical document on the other computing device.
- [c48] 48. The method of claim 37 wherein the modifying includes calling a method of an XML document object model.
- [c49] 49. The method of claim 37 wherein the modifying is performed by a user.

- [c50] 50. The method of claim 49 wherein the user is a client-side application program that implements business logic.
- [c51] 51. The method of claim 49 wherein the user is a human.
- [c52] 52. The method of claim 49 wherein the user uses an application program interface of the client component.
- [c53] 53. A system for enabling authors to work on a hierarchical document, comprising:
 a component that exchanges messages with a client computing device;
 a component that loads a hierarchical document; and
 a component that receives a message relating to a mutation request from the client computing device, determines whether the mutation request can be applied to the hierarchical document, applies the mutation to the hierarchical document, and sends an indication message of an applied mutation to the client computing device.
- [c54] 54. The system of claim 53 wherein the indication message of an applied mutation is an answer message to a client that made the mutation request.
- [c55] 55. The system of claim 53 wherein the indication message of an applied mutation is a broadcast message to a client that did not make the mutation request.
- [c56] 56. The system of claim 53 wherein the determining includes receiving an indication from a server-side application that implements business logic.
- [c57] 57. The system of claim 53 wherein the determining includes checking a privilege.

- [c58] 58. The system of claim 53 wherein the hierarchical document is represented as a tree.
- [c59] 59. The system of claim 58 wherein the tree is represented in XML.
- [c60] 60. The system of claim 53 wherein a message is represented in XML.
- [c61] 61. The system of claim 53 wherein a message includes mutations relating to multiple nodes.
- [c62] 62. The system of claim 53 wherein a message includes mutations relating to a node.
- [c63] 63. The system of claim 53 wherein the determining includes checking whether a node is in the document.
- [c64] 64. The system of claim 53 including a component for storing the applied mutation in a log of mutations.
- [c65] 65. The system of claim 64 including a component for creating a view of the hierarchical document based on a snapshot of the hierarchical document and the applied mutation stored in the log of mutations.